

THE INVENTION CLAIMED IS:

1. An apparatus for drying a substrate, the apparatus comprising:

a first linear nozzle;

5 a fluid supply coupled to the first linear nozzle;

a second linear nozzle positioned proximate the first linear nozzle such that drying vapors therefrom affect the fluid sprayed from the first nozzle to create a Marangoni drying effect;

10 a drying vapor source coupled to the second linear nozzle; and

a mechanism for passing the substrate past the first and second linear nozzles within an operative distance such that the substrate is dried by the Marangoni drying effect.

2. The apparatus of claim 1 wherein the first linear nozzle comprises one nozzle and extends the diameter of the substrate so that rinsing fluid spray wets each portion of the substrate's diameter.

3. An apparatus for drying a substrate, the apparatus comprising:

25 a first array of fan type nozzles which extends at least the radius of the substrate;

a fluid supply coupled to the first array of fan type nozzles;

30 a second array of fan type nozzles positioned proximate the first array of fan type nozzles such that drying vapors therefrom affect the fluid sprayed from the first nozzle to create a Marangoni drying effect;

a drying vapor source coupled to the second array of fan type nozzles; and

a mechanism for passing the substrate past the first array of fan type nozzles and second array of fan type nozzles within an operative distance such that the substrate is dried by the Marangoni drying effect.

4. The apparatus of claim 3 further comprising a controller operatively coupled to the first and second array of fan type nozzles such that a plurality of the nozzles in the array can be independently turned ON and OFF, wherein the first and second arrays extend the diameter of the substrate.

5. A method of drying a substrate comprising:
spraying a fluid from a first linear nozzle at a surface of the substrate;
spraying drying vapors, from a second linear nozzle positioned proximate the first linear nozzle, to the surface of the substrate such that the drying vapors affect the fluid sprayed from the first linear nozzle thereby creating a Marangoni drying effect at the substrate surface; and

moving the substrate relative to the first and the second linear nozzles within an operative distance such that the substrate is dried by the Marangoni drying effect.

6. The method of claim 5 wherein spraying fluid from a first linear nozzle to a surface of the substrate comprises wetting the entire diameter of the substrate's surface.

7. A method of drying a substrate comprising:
spraying a line of fluid to a substrate,
thereby creating an air/fluid interface line on the
substrate;

5 supplying a line of drying vapors to the
air/fluid interface line, thereby creating a Marangoni
drying effect along the air/fluid interface line; and
moving the substrate relative to the
air/fluid interface line.

10 8. The method of claim 7 wherein spraying a line
of fluid comprises spraying fluid from a plurality of fan
type nozzles.

15 9. An apparatus for rinsing and drying a
substrate, comprising:
a tank of fluid, for at least partially
submerging a substrate, the tank comprising a first portion
for receiving the substrate and a second portion that is
20 horizontally adjacent the first portion; and
a lift mechanism for lifting the substrate
from the second portion of the tank.

25 10. The apparatus of claim 9, further comprising
a substrate shuttle operatively coupled within the tank for
receiving the substrate within the first portion and for
shuttling the substrate to the second portion.

30 11. The apparatus of claim 9, further comprising:
a drying vapor source positioned to supply
drying vapors to an air/substrate/fluid interface formed as
the substrate is lifted from the second portion of the tank
by the lifting mechanism.

12. A method for rinsing and drying a substrate comprising:

at least partially submerging a substrate in
5 a first portion of a tank of fluid; and

lifting the substrate from a second portion
of the tank of fluid that is horizontally adjacent the first
portion of the tank of fluid.

10 13. The method of claim 12, further comprising
shuttling the substrate from the first portion of the tank
of fluid to the second portion of the tank of fluid.

14. The method of claim 12, further comprising
15 supplying drying vapor to an air/substrate/fluid interface
formed as the substrate is lifted from the second portion of
the tank of fluid.

15 15. An apparatus for rinsing and drying a
20 substrate comprising:

a tank of cleaning fluid, for submerging a
substrate, the tank comprising a first portion for receiving
and cleaning the substrate and a second portion, operatively
coupled to the first portion, for rinsing the substrate, the
25 first and second portions being horizontally adjacent;

a lifting mechanism operatively coupled to
the tank for lifting a substrate from the cleaning fluid;

a drying vapor source positioned to supply
drying vapors to the air/substrate/rinsing fluid interface;

30 and

a substrate shuttle operatively coupled
within the tank for receiving the substrate within the first

portion and for shuttling the substrate to the second portion.

16. The apparatus of claim 15, wherein the
5 apparatus further comprises a drying enclosure operatively coupled above the second portion of the tank for receiving substrates therefrom, wherein the drying enclosure encloses the drying vapor source.

10 17. The apparatus of claim 16 further comprising:
a lifting mechanism for lifting a substrate from the substrate shuttle to the drying enclosure.

15 18. The apparatus of claim 16 further comprising
a mechanism adapted to hold the wafer in a fixed position relative to the drying enclosure.

19. The apparatus of claim 16 wherein the drying enclosure further comprises a side wall having a sealable
20 opening for substrate extraction.

20. The apparatus of claim 9 wherein the first portion of the tank comprises a transducer adapted to sonically clean a substrate.

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21. The apparatus of claim 10 wherein the first portion of the tank comprises a transducer adapted to sonically clean a substrate.

30 22. The apparatus of claim 11 wherein the first portion of the tank comprises a transducer adapted to sonically clean a substrate.

23. The method of claim 12 further comprising cleaning the substrate in the first portion of the tank.

24. The method of claim 12 further comprising
5 cleaning the substrate in the second portion of the tank.

25. The method of claim 12 further comprising cleaning the substrate in the first and second portion of the tank.

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26. The method of claim 14 further comprising cleaning the substrate in the first portion of the tank.

27. The method of claim 13 further comprising
15 cleaning the substrate in the first portion of the tank.

28. The method of claim 14 further comprising cleaning the substrate in the second portion of the tank.

29. The method of claim 13 further comprising
20 cleaning the substrate in the second portion of the tank.

30. The method of claim 13 further comprising cleaning the substrate in the first and second portion of
25 the tank.

31. The method of claim 13 further comprising cleaning the substrate in the first and second portion of the tank.

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32. The apparatus of claim 15 wherein the first portion of the tank comprises a transducer adapted to sonically clean the substrate.

33. The apparatus of claim 16 wherein the first portion of the tank comprises a transducer adapted to sonically clean the substrate.

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34. The apparatus of claim 17 wherein the first portion of the tank comprises a transducer adapted to sonically clean the substrate.

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35. The apparatus of claim 18 wherein the first portion of the tank comprises a transducer adapted to sonically clean the substrate.

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36. The apparatus of claim 19 wherein the first portion of the tank comprises a transducer adapted to sonically clean the substrate.